* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]A light emitting device arranged on a base material.
A fluorescent substance which can absorb a part of luminescence from this light emitting device and in which light can emit light rather than it in long wavelength.
Resin which contains said fluorescent substance at least and surrounds said light emitting device.
it is the luminescent device provided with the above, and is characterized by volume of said resin being 50 times - twice [10^6] the volume of said light emitting device.

[Claim 2]The luminescent device according to claim 1 whose volume of said resin is 1-mm^3 - 1-cm^3.
[Claim 3]The luminescent device according to claim 1 to 2 which said light emitting device has a nitride based compound semiconductor, and is the yttrium aluminum garnet fluorescent substance in which said fluorescent substance was activated with cerium.
[Claim 4]The luminescent device according to claim 3 with which said nitride semiconductor contains In and said yttrium aluminum garnet fluorescent substance contains Gd.
[Claim 5]The luminescent device according to claim 1 to 2 which said light emitting device has a nitride based compound semiconductor, and is nitrogen content CaO-aluminum$_2O_3$-SiO_2 by which said fluorescent substance was activated by Eu and/or Cr.
[Claim 6]The luminescent device according to claim 1 to 5 with which said resin has a coloring matter with high transmissivity by the long wavelength side from transmissivity of main-light-emission wavelength from said fluorescent substance.
[Claim 7]The luminescent device according to claim 6, wherein said coloring matter has particle diameter with it. [than said fluorescent substance] [small and specific gravity and]

[larger]

[Claim 8]The luminescent device according to claim 7 ranges of whose mean particle diameter of said coloring matter are 10 micrometers - 60 micrometers.

[Claim 9]The luminescent device according to claim 6 to 8, wherein said colorant consists of a coated layer of a metallic oxide whose refractive index is higher than mica and mica provided in said mica surface.

[Claim 10]The luminescent device according to claim 6 to 7 which main-light-emission wavelength of said light emitting device has in the range of 400 nm - 530 nm.

[Claim 11]A formation method of a luminescent device which absorbs a part of luminescence from a light emitting device characterized by comprising the following arranged on a base material, and this light emitting device, and has a fluorescent substance in which light of long wavelength can emit light rather than it.

The first process that viscosity makes distribute a fluorescent substance uniformly at least in resin which is the range of 3500 mPa-s - 20000 mPa-s.

the second process that makes resin obtained at said first process fill up into the circumference of said light emitting device with volume 50 times - twice [10^6] the quantity of said light emitting device, and stiffens it.

[Claim 12]A formation process of the luminescent device according to claim 11 making a coloring matter with high transmissivity contain, and making it distribute uniformly by the long wavelength side from transmissivity of main-light-emission wavelength from said fluorescent substance with said fluorescent substance in said resin in said first process.

[Claim 13]A formation method of the luminescent device according to claim 12, wherein said coloring matter has particle diameter with it. [than said fluorescent substance] [small and specific gravity and] [larger]

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is the long wavelength conversion type luminescent device which used for the back light, the illumination light source, various indicators, a traffic light of the liquid crystal, etc. the semiconductor light emitting element by which bonding was carried out to the base material, and the fluorescent substance in which the visible light of long wavelength can emit light rather than it with respect to the available luminescent device. There is especially this invention in providing the long wavelength conversion type luminescent device which can raise light emitting luminance by leaps and bounds.
[0002]
[Description of the Prior Art]The LED tip in which blue glow used the nitride semiconductor ($In_xGa_yaluminum_{1-x-y}N$, 0<=x<=1, 0<=y<=1) which is a semiconductor light emitting element which can emit light to high-intensity was developed today. As compared with the light emitting device which emits light in yellowish green from the red using materials, such as other GaAs (es) and AlInGaP, the light emitting device using a nitride semiconductor with a high output. Although the color shift by temperature has the features, like it is few, there is a tendency that it can be hard to obtain high power in the long wavelength region which has the wavelength more than green, the place by the present. On the other hand, at least a part of blue glow emitted from the LED tip on this LED tip was absorbed, and the light emitting diode with which a white system can emit light was developed by arranging the YAG:Ce fluorescent substance etc. which are the fluorescent substances in which yellow can emit light. (International publication number WO 98/No. 5078)
[0003]This light emitting diode, for example in spite of the comparatively easy composition of 1 chip 2 terminal structure like drawing 4, Light is emitted via the convex lens 11 in the mixed-colors light of the light from the LED tip electrically connected to the mount lead and the inner

lead, and the light from fluorescent substances, such as YAG:Ce contained in the resin which covers a LED tip.

[0004]This light emitting diode can make which white light that the yellow taste cut emit arbitrarily by making the amount of the fluorescent substance used adjust from the white bluish among the mixed-colors lights emitted from a luminescent device. Desired neutral colors can also be made to emit light by adding paints and making light absorb selectively.

[0005]Although such a light emitting diode is beginning to be used for various fields, the characteristic of high-intensity, low power consumption, or a long lasting light emitting diode is made use of, and it is beginning to be positively used in the field of traffic lights, such as an object for railroads. The luminescent color is specified based on the electric bulb, and especially the traffic light for railroads is made white [the color of an electric bulb]. Therefore, especially the light emitting diode that can emit light to high-intensity in the white which the yellow taste cut is called for.

[0006]However, it is in the tendency for the light emitting luminance of what can adjust the luminescent color to fall, only by increasing the content of the fluorescent substance only contained in a light emitting diode. On the other hand, when the content of a fluorescent substance is reduced, it has a relation of trade-off that the luminescent color of what can raise luminosity cannot be adjusted.

[0007]

[Problem(s) to be Solved by the Invention]Therefore, the purpose of the invention in this application is to provide the light emitting diode which can adjust the luminescent color in a little amount of fluorescent substances. Also in the neutral colors it was impossible to have made high-intensity emit light the long wavelength side of visible light and conventionally especially, the light emitting diode which can emit light to high-intensity is provided.

[0008]

[Means for Solving the Problem]A luminescent device of this invention absorbs a part of luminescence from a light emitting device arranged at a base material, and this light emitting device, and A fluorescent substance in which light of long wavelength can emit light rather than it, it is a luminescent device which has resin which contains said fluorescent substance at least and surrounds said light emitting device, and is characterized by volume of said resin being 50 times - twice [10^6] the volume of said light emitting device.

[0009]By constituting in this way, the state where a fluorescent substance was distributed good in resin is acquired, and a luminescent device which can emit light to high-intensity is obtained in light of a request by necessary minimum fluorescent substance content being also. Volume of desirable resin is 1-mm^3 - 1-cm^3.

[0010]A light emitting device has a nitride based compound semiconductor, and it is characterized by a fluorescent substance being the yttrium aluminum garnet fluorescent

substance activated with cerium. It becomes possible to make a long time emit light by using such a fluorescent substance, and the reliability of a luminescent device improves.

[0011]Said nitride semiconductor contains In and said yttrium aluminum garnet fluorescent substance contains Gd. By constituting in this way, a higher-intensity mixed-colors light with the long wavelength side is obtained.

[0012]In this invention, nitrogen content CaO-aluminum$_2O_3$-SiO_2 activated by Eu and/or Cr is suitably mentioned as another fluorescent substance used with a light emitting device which has a nitride based compound semiconductor.

[0013]A coloring matter with high transmissivity may be made to contain with a fluorescent substance in resin which surrounds a light emitting device at a long wavelength side [transmissivity / of main-light-emission wavelength from said fluorescent substance]. All neutral colors in a chromaticity diagram can also be made to emit arbitrarily by constituting in this way. As for a coloring matter, it is more preferred than said fluorescent substance that it is particle diameter with it. [small and specific gravity and] [large] Thus, by adjusting specific gravity of a fluorescent substance and a coloring matter, and a relation of particle diameter, a fluorescent substance in inside of resin and the dispersibility of the coloring matter itself improve, and desired luminescence is obtained. Ranges of desirable mean particle diameter of a coloring matter are 10 micrometers - 60 micrometers. In number distribution and volume distribution of a coloring matter, when a total of the range of 10 micrometers - 60 micrometers forms not less than 99% of the whole, specifically, it is desirable. A coloring matter which consists of a coated layer of a metallic oxide as a concrete coloring matter whose refractive index is higher than mica and mica provided in said mica surface is used suitably. If the tunic of the metallic oxide which consists of iron oxide especially is carried out on the surface of mica by 40% - 60% of coverage, tinting strength and gloss power will improve, and a luminescent device which can emit light to Haruka or high-intensity conventionally in purple etc. is obtained.

[0014]As for dominant wavelength of a light emitting device used for this invention, it is preferred that it is the range of 400 nm - 530 nm. If such a light emitting device is used, white light which a yellow taste cut from bluish white light can be made to emit arbitrarily.

[0015]As for this invention, a formation method of a luminescent device of this invention is characterized by that a formation method of a luminescent device which absorbs a part of luminescence from a light emitting device arranged on a base material and this light emitting device, and has a fluorescent substance in which light of long wavelength can emit light rather than it comprises the following.

The first process that viscosity makes distribute a fluorescent substance uniformly at least in resin which is the range of 3500 mPa-s - 20000 mPa-s.

the second process that makes resin obtained at said first process fill up into the

circumference of said light emitting device with volume 50 times - twice [10^6] the quantity of said light emitting device, and stiffens it.

[0016]Resin can be stiffened being able to distribute a fluorescent substance good in resin, and maintaining the good dispersion state with such a formation method. Each fluorescent substance can fully demonstrate an original operation by this, and a luminescent device with possible making light of all requests emit light to high-intensity to white light which a yellow taste cut from white light which is bluish in a little content being is obtained.
[0017]In said first process, into said resin, a coloring matter with high transmissivity may be made to contain by the long wavelength side from transmissivity of main-light-emission wavelength from said fluorescent substance, it may be made to distribute uniformly with said fluorescent substance, and a luminescent device may be formed using resin obtained by this. When a coloring matter has particle diameter with it, it is preferred. [than a fluorescent substance] [small and specific gravity and] [larger]
[0018]Thus, a luminescent device which was excellent in mixed-colors nature, such as all neutral colors in a chromaticity diagram, can be formed with a sufficient yield by making it contain in resin with high viscosity in consideration of [both] relation between a fluorescent substance and a coloring matter.
[0019]
[Embodiment of the Invention]In the luminescent device with which this invention person used the fluorescent substance as a result of various experiments, By adjusting the specific gravity of the fluorescent substance and coloring matter of volume with the resin which contains a fluorescent substance in part at least, and surrounds a light emitting device and said light emitting device which are made to be [a coloring matter / it] related and contain, and the relation of particle diameter, it finds out that selection of a color tone can be performed easily and light emitting luminance can be improved greatly, and came to accomplish this invention.
[0020]When a part of the light and light from a light emitting device are changed by the fluorescent substance and it uses mixed-colors light with the light of reliance long wavelength, the luminescent color of all requests can be obtained by cutting the wavelength of a certain ingredient among emission spectra.
[0021]Paints can be used as a method of cutting the ingredient of a certain wavelength and obtaining mixed-colors light. However, when paints are only used, it is in the tendency for light to be concealed by paints and for luminosity to fall greatly.
[0022]If the content of a fluorescent substance increases even if it is translucency when making translucency members, such as resin of translucency, and glass, contain a fluorescent substance, The rate which it is close, and reflection, dispersion, etc. take place repeatedly between precipitating fluorescent substances, and is absorbed with translucency resin etc.

increases, or light is shut up between fluorescent substances. Therefore, the radiant power output of the mixed-colors light obtained declines remarkably.

[0023]Then, this invention provides the luminescent device with which mixed-colors light can emit light to high-intensity only by the minimum content needed without needing a lot of paints and fluorescent substances. The luminescent device which can emit light to high power and high-intensity is obtained in mixed-colors lights, such as the neutral colors of the field below the straight line which connected the starting point and a white domain on the chromaticity diagram by this, especially the color near the bottom line of a CIE chromaticity, for example, purple etc.

[0024]Drawing 3 is a typical sectional view of the SMD type light emitting diode of this invention. passing the buffer layer which is gallium nitride on silicon on sapphire -- a nitride semiconductor (aluminum$_x$Ga$_y$In$_z$N.) The light emitting device 2 in which it comes to form the pn junction which consists of 0<=x<=1, 0<=y<=1, 0<=z<=1, and X+Y+Z=1 is arranged on the glass epoxy board 1 which has the lead electrodes 3 and 4 of a couple. The light emitting device 2 has a luminous layer which consists of nitride semiconductor layers at least. Each electrode provided in one field side of such a light emitting device 2 is electrically connected with the lead electrodes 3 and 4 of the couple with the conductive paste 5, such as solder and Ag paste, by flip chip bonding, respectively. The light emitting device 2 installed in this way absorbs a part of light emitted from the light emitting device at least on the light emitting device, and is covered with the epoxy resin 7 uniformly with the fluorescent substance 6 more nearly convertible into long wavelength. It cannot be overemphasized that the light emitting diode of this invention can be used for the light emitting diode of various gestalten, such as not only an SMD type light emitting diode such but a display display, 8 segmental dies, an artillery shell type, etc. Hereafter, each composition of the light emitting diode used for this invention is explained in full detail.

[0025](Resin 7) The resin 7 used suitably for this invention reflects at least a part of luminescence from a LED tip. As a concrete material, transparent resin, glass, etc. excellent in weatherability, such as an epoxy resin, an acrylic resin, and silicone, are used suitably.

[0026]The specific gravity of a fluorescent substance reaches by several times the liquefied resin, and, in the case of thermosetting resin, after-heating viscosity falls greatly. For this reason, when the fluorescent substance was made to contain, and was only mixed in resin and a light emitting device is surrounded and stiffened, the actual condition is the fluorescent substance in resin being thickly [almost] bulky to the light emitting device circumference, and sedimenting. It is considered to be a fluorescent substance located in the maximum contiguity of the light emitting device circumference, or a fluorescent substance located in the fluorescent material layer surface that the light from a light emitting device is efficiently absorbable among these fluorescent substances. Most fluorescent substances stacked thickly do not demonstrate

the original operation. It is thought that these fluorescent material layers that have sedimented thickly densely conceal the light from a light emitting device and the excitation light from a fluorescent substance, and the fall of a radiant power output and luminosity produces them.
[0027]so, in this invention, volume of the fluorescent substance content resin which surrounds a light emitting device is made into 50 times - twice [10^6] the volume of said light emitting device. Thus, if a resin amount is adjusted, it can control the contained fluorescent substance being bulky and sedimenting. When the light emitting device volume of a resin body product is smaller than 50 times, a fluorescent substance will sediment bulky and luminosity will fall greatly. if it becomes larger than 10^6 twice, the optical extraction efficiency to the exterior of the excitation light by the light and the fluorescent substance from a light emitting device will fall. Therefore, without shutting up light between fluorescent substances by forming a luminescent device in the range of the resin amount by this invention, the conversion efficiency and the optical extraction efficiency of each fluorescent substance can be raised, and the luminescent device which can emit light to high-intensity is obtained. When a light emitting device is 350micrometerx350micrometerx80micrometer, specifically, desirable resin amounts are 1-mm^3 - 1-cm^3.
[0028]The extraction course to the exterior of the light which emits light from a light emitting device is extended by providing a resin layer thickly and/or broadly. By this, light will repeat reflective refraction within resin and a long wavelength component will be cut. The fluorescent substance distributed good is made to absorb efficiently the light from the light emitting device by which reflective refraction was carried out within resin, i.e., the cut light, in this invention. That is, this invention is cut by taking out the short wavelength ingredient taken out outside and making a course extend, and a resin amount is set up so that it may become possible to make it use efficiently as a short wavelength ingredient which has the cut short wavelength ingredient excited. Most long wavelength components which the change of the color tone of was attained by a little fluorescent substance content by this, and were changed with the fluorescent substance can be taken out to the exterior good.
[0029]Thus, the luminescent device in this invention can raise the absorption efficiency to a fluorescent substance, and can increase a long wavelength component while it reduces the optical extraction efficiency of the short wavelength ingredient from a light emitting device among emission spectra. Since the mixed-colors light of long wavelength is obtained by the amount of few fluorescent substances used by this, the extraction efficiency of the long wavelength component from a fluorescent substance can improve, and light can be emitted to high-intensity in mixed-colors light. This invention does not need paints but makes it possible to also make the color of a fluorescent substance and similar colors emit light to high-intensity only with a little fluorescent substances.

[0030]As for the resin used for this invention, it is preferred that the viscosity before hardening is hyperviscous resin of 3500 mPa-s - 20000 mPa-s. If a fluorescent substance is added to these resin and it is distributed uniformly, sedimentation of a fluorescent substance can be controlled further and a uniform and good dispersion state can be maintained over a long time. That is, if a light emitting device is surrounded and stiffened in hyperviscous resin by the resin which distributed the fluorescent substance, resin will be hardened, a fluorescent substance's hardly precipitating but maintaining a desirable dispersion state. In all the fluorescent substances that this contained, an original operation can fully be demonstrated, and selection of a color tone is attained by a little fluorescent substance content. The precision level at the time of making fluorescent substance content resin fill up with a dispenser improves, and the yield improves. As a desirable resin material, silicone resin, a room-temperature-setting type epoxy resin, an ordinary temperature dry-sand-mould acrylic resin, etc. are raised.
[0031]Thus, the luminescent device which the influence by change of outside air temperature is hardly received, but can emit light to high-intensity because make resin with high viscosity distribute a fluorescent substance and you make it volume greatly filled up with thickness for them around a light emitting device thickly preferably can be formed.
[0032]In this invention, it is computed with the viscosity of resin by the viscosity meter indicated value which uses a rotation viscometer for liquefied resin of an additive-free state, and might be examined here in the interior of a room of the temperature of 23 **, and 50% of relative humidity (JIS K7117).
[0033](Fluorescent substance 6) The photoluminescence fluorescent substance 6 used for the luminescent device of the invention in this application is a photoluminescence fluorescent substance which is excited by visible light and ultraviolet rays which emitted light from the semiconductor light layer, and emits light. Although the yttrium aluminum garnet system fluorescent substance activated with cerium as a concrete example of a photoluminescence fluorescent substance as a fluorescent substance in which a white system can emit light by the complementary color with the light emitting device in which a blue system can emit light is mentioned, The fluorescent substance which mixed two or more fluorescent substances and these fluorescent substances, such as $Mg_5Li_6Sb_6O_{13}$:Mn and Mg_2TiO_4:Mn, can also be used. In this invention, it is excited in response to the light from a light emitting device, and various fluorescent substances which can emit light in the visible light of long wavelength can be suitably used rather than it. The yttrium aluminum garnet system fluorescent substance activated with cerium as a more suitable fluorescent substance is shown below.
[0034]In this specification, especially the yttrium aluminum garnet system fluorescent substance activated with cerium shall be interpreted in a broad sense. It is used for the large meaning containing the fluorescent substance which emits the scintillation effect which replaces some or the whole of yttrium by at least one element chosen from the group which

consists of Lu, Sc, La, Gd, and Sm, or replaces a part or the whole of aluminum by any of Ga and In, or both.

[0035]In detail General formula $(Y_zGd_{1-z})_3aluminum_5O_{12}$:Ce. The photoluminescence fluorescent substance and general formula $(Re_{1-a}Sm_a)_3Re'_5O_{12}$:Ce which are shown by (0< z<=1 [however,]). (however, 0<=a<1, 0<=b<=1, and Re are chosen from Y, Gd, La, and Sc -- a kind and Re' at least are chosen from aluminum, Ga, and In -- it is a kind at least.) -- it is a photoluminescence fluorescent substance shown.

[0036]In this invention, it can provide high-intensity with color tones including white, such as a bulb color, by the content of few fluorescent substances by adjusting the fill ration of resin of the fluorescent substance content which surrounds a light emitting device.

[0037]Distribution of the photoluminescence fluorescent substance used for this invention can be made to form variously by making a member, forming temperature, shape of a photoluminescence fluorescent substance, particle size distribution, etc. containing a photoluminescence fluorescent substance adjust. Therefore, various distribution concentration of a fluorescent substance can be chosen according to a service condition etc. In order to carry out uniform light emission, although it is preferred that the fluorescent substance is distributed uniformly, many things can be chosen according to an operating mode.

[0038]The yttrium aluminum garnet system fluorescent substance activated with cerium of this invention, Or it touches especially a LED tip, it approaches, and it is arranged and can be considered as the light emitting diode of the luminescent characteristic which has lightfastness sufficient efficient and was [more than (Ee) =3 $W\text{-}cm^{-2}$] excellent in below 10 $W\text{-}cm^{-2}$ as irradiation intensity.

[0039]This fluorescent substance can be strong for heat, light, and moisture, and can make the peak of an excitation spectrum carry out near 450 nm for garnet structure. It has a broadcloth emission spectrum in which a light emission peak is also near 580 nm, and lengthens the skirt to 700 nm.

[0040]The photoluminescence fluorescent substance used for the invention in this application can make high excited light efficiency of a not less than 460-nm long wavelength region by containing Gd (gadolinium) during a crystal. By the increase in the content of Gd, an emission peak wavelength moves to long wavelength, and also shifts the whole luminous wavelength to the long wavelength side. And a luminous wavelength shifts to the long wavelength side in a luminous wavelength shifting to the short wavelength side in replacing a part of aluminum by Ga among the presentations of an yttrium aluminum garnet system fluorescent substance with garnet structure, and replacing a part of Y of a presentation by Gd.

[0041]In order to replace a part of Y by Gd, it is preferred to set it as the ratio of the range of Y:Gd=9:1 to 1:9, and it is more preferred to set it as the range of 4:1 to 2:3. In less than twenty

percent, a green component is large and the substitution of a red ingredient to Gd decreases. The substitution to Gd is in the tendency for the luminosity of that whose redness ingredient increases to fall rapidly, in 60 percent or more. Especially, By considering it as the range of Y:Gd=4:1 to 2:3 among the presentations of an yttrium aluminum garnet system fluorescent substance, although based on the luminous wavelength of a LED tip. A black-body-radiation locus is about met using one kind of yttrium aluminum garnet system fluorescent substance, and it can be considered as the light emitting diode with which white light can emit light. It is more than Y:Gd=2:3 and luminosity can consider it as the light emitting diode with which the bulb color of what becomes low can emit light in 1:4. As for content (substitution) of Ce, 0.003 to 0.5 is preferred.

[0042]The photoluminescence fluorescent substance of the invention in this application can adjust the luminescent color continuously by changing a presentation in this way. In Hg luminescent lines, such as 254 nm and 365 nm, it is hardly excited, but the excitation efficiency by the light from blue system LED tips, such as near 450 nm, is high. Therefore, it has the ideal conditions for changing blue system luminescence of a nitride semiconductor -- the intensity by the side of long wavelength is continuously changed by the composition ratio of Gd -- into luminescence of a white system, and excels extremely.

[0043]An oxide or the compound which turns into an oxide easily at an elevated temperature is used for such a photoluminescence fluorescent substance as a raw material of Y, Gd, Ce, aluminum, and Ga, it fully mixes them by a stoichiometric ratio, and obtains a raw material. Or the coprecipitation oxide produced by calcinating what coprecipitated the solution which dissolved the rare earth element of Y, Gd, and Ce in acid by the stoichiometric ratio with oxalic acid, and an aluminum oxide and gallium oxide are mixed, and a mixed raw material is obtained. A proper quantity of fluorides, such as ammonium fluoride, are mixed as flux to this, crucible is stuffed, it can calcinate in the temperature requirement of 1350-1450 degreein the air C for 2 to 5 hours, a burned product can be obtained, and it can obtain by carrying out the ball mill of the burned product underwater next, and letting a screen pass at washing, separation, desiccation, and the last.

[0044]In the luminescent device of the invention in this application, such a photoluminescence fluorescent substance may mix the yttrium aluminum garnet fluorescent substance and other fluorescent substances which were activated with two or more kinds of cerium.

[0045]Similarly, the nitrogen content CaO-aluminum$_2O_3$-SiO_2 fluorescent substance activated by Eu and/or Cr is mentioned as other concrete fluorescent substances used for this invention. The nitrogen content CaO-aluminum$_2O_3$-SiO_2 fluorescent substance activated by this Eu and/or Cr, Raw materials, such as an aluminum oxide, yttrium oxide, silicon nitride, and a calcium oxide, are made to fuse and fabricate the powder which mixed the rare earth raw material to the predetermined ratio in 1300 ** to 1900 ** (from 1500 ** to 1750 ** [Preferably])

in the bottom of a nitrogen atmosphere. The ball mill of the mold goods can be carried out, and a fluorescent substance can be made to form in washing, separation, desiccation, and the last through a screen. It can be considered as the excitation spectrum which had a peak in 450 nm by this, and the Ca-aluminum-Si-O-N system oxy nitride fluorescence glass activated by Eu and/or Cr in which red light can emit light by the blue glow which has a peak in about 650 nm.

[0046]The peak of an emission spectrum can be continuously shifted from 575 nm to 690 nm by fluctuating the nitrogen content of the Ca-aluminum-Si-O-N system oxy nitride fluorescence glass activated by Eu and/or Cr. Similarly, an excitation spectrum can also be shifted continuously. Therefore, a white system can be made to emit light by the synthetic light of the light from the gallium nitride system compound semiconductor which contains in a luminous layer GaN by which impurities, such as Mg and Zn, were doped, and InGaN, and the light of about 580-nm fluorescent substance. In particular, about 490-nm light can also obtain luminescence ideal for combination with the light emitting device which consists of a gallium nitride system compound semiconductor which contains in a luminous layer InGaN which can emit light to high-intensity.

[0047]moreover -- using the light emitting device in which a blue system can emit light by combining the nitrogen content Ca-aluminum-Si-O-N system oxy nitride fluorescence glass activated by the YAG system fluorescent substance, Eu, and/or Cr which were activated by above-mentioned Ce -- RGB (red and green.) The light emitting diode with very high color rendering properties which contains a blue ingredient in high-intensity can also be made to form. For this reason, arbitrary neutral colors can also be made to form very simply only by adding desired paints. In this invention, any fluorescent substance is an inorganic fluorescent substance, and the light emitting diode with which high contrast and the outstanding mass production nature were compatible can be made to form using an organic light scattering agent, SiO_2, etc.

[0048](Coloring matter 12) Colorant with high transmissivity may be made to contain by the long wavelength side with a fluorescent substance in this invention in the resin which surrounds a light emitting device from the transmissivity of the main-light-emission wavelength from said light emitting device. As for both the coloring matters used, what has particle diameter with it is more preferred than the fluorescent substance to contain. [small and specific gravity and] [large] Thus, a fluorescent substance and a light and large coloring matter can act each other, the dispersibility in the inside of resin can be raised, and the excitation light changed by the fluorescent substance can be entered in a coloring matter with high probability. A coloring matter distributes mechanically the floc of a crystal or three firm combined particles [two pieces -] of those, and is adjusted to desired particle diameter. If particle diameter is adjusted smaller than 10 micrometers, what was distributed once will condense again and will cause color unevenness. Then, the desirable particle diameter of the

coloring matter used for this invention is 10 micrometers - 60 micrometers, and is 30 micrometers - 60 micrometers more preferably. It can be made to distribute uniformly in resin by adjusting in this way, without making a coloring matter condense.

[0049]The smooth thing of the surface of a coloring matter is preferred. The absorbance of a coloring matter can improve with constituting in this way, and the light from a fluorescent substance can be changed efficiently.

[0050]As for the coloring matter of this invention, it is preferred that it is flake shape in order to raise efficiency. Flake shape is the particles which length and width had a similar size and had the very larger special feature than the other neighborhood. As suitable flake shape of this invention, the sizes of the larger one are about 2 micrometers - 15 micrometers, and thickness is about 0.02 micrometer - 5 micrometers. By using the coloring matter which consists of such flake shape, orientation of the coloring matter is carried out in parallel in resin, it can reflect the incident light to each coloring matter in a certain direction regularly, and can obtain an ideal mixed-colors light.

[0051]What specifically carried out the tunic with the metallic oxide which has a high refractive index as an un-opaque flake-like output using mica is mentioned. What is necessary is just to make iron oxide etc. more specifically adhere at about 46% of the rate of a tunic on mica, when making purple light emit light to high-intensity. As for particle diameter, 10 micrometers - 60 micrometers are preferred.

[0052]The coloring matter used for the invention in this application has a preferred inorganic substance. A nitride semiconductor device is used, and when it is made to arrange near the light emitting device, such as touching directly, since the output of a light emitting device is large, degradation of the coloring matter itself poses a big problem. The moisture contained in the inside of what is protected by resin etc., and the moisture which invaded from the outside exist around the coloring matter used for a luminescent device. There are electrical and electric equipment for a drive, extraneous light, etc., and it can be necessary to stabilize and use it under very severe environment. Therefore, an inorganic substance is preferred.

[0053](Light emitting device 2) In this invention, the light emitting device 2 is surrounded by the resin which contains a fluorescent substance in part at least. The light emitting device of the invention in this application is a nitride based compound semiconductor which can excite efficiently the yttrium aluminum garnet system fluorescent substance activated with cerium. Here, as a nitride based compound semiconductor (general formula $In_iGa_jaluminum_kN$ however 0<=i, 0<=j, 0<=k, i+j+k=1), various things including GaN by which InGaN and various impurities were doped are contained. The LED tip which is a light emitting device makes semiconductors, such as InGaN and GaN, form as a luminous layer on a substrate by the MOCVD method etc. As a structure of a semiconductor, the thing of terrorism structure is mentioned to the gay structure, hetero structure, or double which has MIS junction, PIN

junction, pn junction, etc. Various luminous wavelengths can be chosen with the material and its degree of mix crystal of a semiconductor layer. A semiconductor active layer can also be made into the single quantum well structure and multiple quantum well structure which were made to form in the thin film which a quantum effect produces. In particular, in the invention in this application, by making the active layer of a LED tip into the multiple quantum well structure which consists of InGaN(s), there is no degradation of a photoluminescence fluorescent substance and it can use as a luminescent device which emits light to high-intensity more.

[0054]When a gallium nitride system compound semiconductor is used, materials, such as sapphire, a spinel, SiC, Si, and ZnO, are used for a semiconductor substrate. In order to make good crystalline gallium nitride form, it is preferred to use a sapphire substrate. Buffer layers, such as GaN and AlN, are formed on this sapphire substrate, and the gallium nitride semiconductor which has pn junction is made to form on it. A gallium nitride system semiconductor shows n type conductivity in the state where an impurity is not doped. When making the n type gallium nitride semiconductor of a request, such as raising luminous efficiency, form, it is preferred to introduce Si, germanium, Se, Te, C, etc. suitably as a n type dopant. On the other hand, when making a p type gallium nitride semiconductor form, Zn, Mg, Be, Ca, Sr, Ba, etc. which are p type DOPANDO are made to dope. Only by doping a p type dopant, since itis [p-type-] hard toize a gallium nitride system compound semiconductor, it is preferred to make it low-resistance-ize after p type dopant introduction by heating, low-speed electron beam irradiation, plasma irradiation at a furnace, etc. After making the exposed surface of a p-type semiconductor and an n-type semiconductor form by etching etc., sputtering process, a vacuum deposition method, etc. are used and each electrode of desired shape is made to form on a semiconductor layer.

[0055]Next, after carrying out full cutting of the semiconductor wafer etc. which were formed directly with the dicing saw which the braid which has the edge of a blade made from a diamond rotates or cutting the slot of width wider than edge-of-a-blade width deeply (half cutting), a semiconductor wafer is broken with external force. or the scriber in which the diamond stylus at a tip carries out a both-way straight-line motion -- a scribe line (circles of longitude) very thin to a semiconductor wafer -- for example, after lengthening in a grid pattern, with external force, a wafer is broken and it cuts into chip shape from a semiconductor wafer. Thus, the LED tip which is a gallium nitride system compound semiconductor can be made to form.

[0056](Lead electrodes 3 and 4) It can be made to be electrically able to connect with each electrode of a LED tip, and the lead electrodes 3 and 4 of this invention can take various shape according to the gestalt of a light emitting diode. Specifically, a gold streak etc. can constitute the mount lead which can arrange a LED tip and a fluorescent substance, and the electrode of another side of a LED tip from an artillery shell type light emitting diode at the electrically

connected inner lead. In the case of SMD type LED etc., the metal plate of a couple can be constituted as a lead electrode.

[0057]It is called for that these lead electrodes have good connectivity and electrical conductivity with the bonding wire etc. which are conductive wires. As a concrete material, aluminum, iron, copper, etc. which plated iron, copper, copper containing iron, copper containing tin and copper, gold, and silver are mentioned. It cannot be overemphasized that it is not what is hereafter restricted only to this although the example of this invention is explained in full detail.

[0058]

[Example](Example 1) The long wavelength conversion type SMD type light emitting diode like drawing 1 is made to form as a light emitting diode of this invention. As the light emitting device 2, it has a luminous layer which consists of InGaN(s), and a main-light-emission peak uses the LED tip which is 470 nm. A LED tip is formed using the MOCVD method. Specifically, the silicon on sapphire washed in the reaction chamber is arranged. As reactant gas, TMG (trimethyl) gas, TMI (trimethylindium) gas, Hydrogen gas is used as TMA (trimethylaluminum) gas, ammonia gas, and carrier gas, silane gas and cyclo pen TAJIA magnesium are used as impurity gas, and membranes are made to form.

[0059]GaN which is a low temperature buffer layer on silicon on sapphire as lamination of a light emitting device, GaN of the Si dope which non-doped GaN (about 15000A in thickness) which raises crystallinity, and an electrode are formed, and works as a n type contact layer (about 21650A in thickness), Non-doped GaN (about 3000A in thickness) which raises crystallinity, GaN non-doped as a n type clad layer (about 50A in thickness), Non-doped GaN (about 40A in thickness) which raises the crystallinity of the multilayer film which consists of superlattice of GaN (about 300A in thickness) which doped Si, and the luminous layer formed on it, As the multilayer film which consists of superlattice of non-doped InGaN (about 20A in thickness), and a luminous layer which consists of multiple quantum well structures, The multilayer film of non-doped GaN (about 200A in thickness), and InGaN (about 20A in thickness), GaN (about 1200A in thickness) by which Mg which is the multilayer film and p type contact layer which consist of superlattice of GaAlN (about 40A in thickness) by which InGaN (about 25A in thickness) by which Mg which works as a p type contact layer was doped, and Mg were doped was doped is made to form.

[0060]In this way, the semiconductor wafer in which the nitride semiconductor which formed membranes was formed is etched selectively, and a p type and a n type contact layer are exposed. After making the electrode of a n type and a p type form on each contact layer using sputtering process, it divides into each light emitting device, and the volume for which blue can emit light forms the LED tip which is about 0.01-mm^3.

[0061]Next, the cavity 10 used by this invention is created by pouring in and hardening a liquid

crystal polymer further in white resin. the titanium oxide powder as a filler with a white liquid crystal polymer to pour in -- about 40wt% -- he is trying to have high reflectance to light with the blue surface in a cavity by mixing

[0062]The compound which turns into an oxide is used for the fluorescent substance 6 used for this invention as a raw material of Y, Gd, Ce, and aluminum, it fully mixes them by a stoichiometric ratio, and obtains a raw material. Or the coprecipitation oxide produced by calcinating what coprecipitated the solution which dissolved the rare earth element of Y, Gd, and Ce in acid by the stoichiometric ratio with oxalic acid, and an aluminum oxide are mixed, and a mixed raw material is obtained. A proper quantity of fluorides, such as ammonium fluoride, are mixed as flux to this, crucible is stuffed, it can calcinate in the temperature requirement of 1350-1450 degreein the air C for 2 to 5 hours, a burned product can be obtained, and it can obtain by carrying out the ball mill of the burned product underwater next, and letting a screen pass at washing, separation, desiccation, and the last. In this way, $_3$ ($Y_{0.8}Gd_{0.2}$) aluminum$_5O_{12}$:Ce is formed as a fluorescent substance of this invention.

[0063]Capacity arranges LED tip 2 to a cavity inner bottom, and makes it connect with the lead electrodes 3 and 4 of a couple by the gold streak 9 using the larger cavity 10 than 1.0-mm^3. And it is filled up with the epoxy resin 7 which is the sealing resin which made 6wt% contain a fluorescent substance so that a LED tip may be surrounded in a 1.0-mm^3 cavity, it is stiffened, and a light emitting diode is made to form. By this, the white light of x and y= (0.33, 0.33) can consider it as the light emitting diode which can emit light to high-intensity in the chromaticity table of CIE.

[0064](Comparative example 1) The amount of epoxy resins is made into 0.2-mm^3, when a fluorescent substance is adjusted so that it may become the same chromaticity point as Example 1, the content of the fluorescent substance to need is 30wt%, and a radiant power output will decrease about 80% from Example 1. It can be said that the light emitting diode of this invention is able to emit light to high-intensity by this at the long wavelength side with low color purity, such as a white system.

[0065](Example 2) The cavity used in Example 1 is enlarged in Example 1, The amount of epoxy resins is made into 2.7-mm^3, when a fluorescent substance is adjusted so that it may become the same chromaticity point as Example 1, the content of the fluorescent substance to need is 6wt%, and a radiant power output improves about 70% from Example 1.

[0066](Example 3) If a light emitting diode is formed like Example 1 except making only the upper levels contain a fluorescent substance among the epoxy resins with which you make it filled up in a cavity, a radiant power output will improve about 10% from Example 1.

[0067](Example 4) Enlarge the cavity used in Example 1 and fluorescent substance content is

fixed with 25wt%, The amount of epoxy resins is changed with 1.35-mm^3 from 1-mm^3, and 2.7-mm^3, and when a LED tip is surrounded and each light emitting diode is made to form, a color tone changes from white to yellow as the volume of resin becomes large. High-intensity luminescence is obtained in all the light emitting diodes.

[0068](Example 5) Resin viscosity in silicone resin which is 4000 mPa-s, Mean particle diameter is 8 micrometers, and specific gravity the fluorescent substance which is about 4.2 3wt%, Are mica which is 46% of a rate of an iron oxide tunic, and the coloring matter whose mean particle diameter is 35 micrometers and whose specific gravity is about 3 And 0.44wt%, If a light emitting diode is formed like Example 1 except surrounding a light emitting device as it is also at the volume of 1.0-mm^3 about the resin which made both contain and was distributed uniformly, The purple-light-emission diode which can emit light to high-intensity [it is x and y= (0.23, 0.125) in the chromaticity table of CIE, and a high-intensity output is 1.23 mW] is obtained.

[0069](Comparative example 2) As resin, the viscosity before hardening uses the heat-hardened type epoxy resin which is 630 mP-s, The fluorescent substance whose mean particle diameter is 4.0 micrometers, and mean particle diameter the coloring matter which is 2.0 micrometers, If a light emitting diode is formed like Example 5 except surrounding a light emitting device as it is also at the volume of 0.5-mm^3 about what made both contain and carried out mixture dispersion, a radiant power output will be set to 10 microwatts, and will decrease substantially.

[0070]

[Effect of the Invention]Especially in the luminescent device of this invention, the fluorescent substance excited by 400 to 530-nm blue LED is used, the extraction efficiency of the light from the possible light emitting device of blue light is reduced, and the incidence efficiency to a fluorescent substance is raised.By adjusting the volume of sealing resin, the luminescent device which paints etc. are not needed but can emit light to high-intensity in a yellow system not to mention white simply only with a little fluorescent substances can be formed.

[0071]A luminescent device can be formed by making a coloring matter contain with a fluorescent substance, and forming a luminescent device into resin, in consideration of the relation between these specific gravity and particle diameter, and the relation of the volume of a light emitting device and the sealing resin to surround, distributing a coloring matter and a fluorescent substance good in resin. For this reason, it becomes possible to adjust the luminescent color with necessary minimum fluorescent substance content, and the luminescence **** can form a luminescent device in high-intensity.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a typical sectional view of the SMD type light emitting diode of this invention.
[Drawing 2]It is a typical sectional view of the SMD type light emitting diode in Example 3 of this invention.
[Drawing 3]It is a typical sectional view of another SMD type light emitting diode of this invention.
[Drawing 4]It is a typical sectional view of the artillery shell type light emitting diode shown for this invention and comparison.
[Drawing 5]The emission spectrum of the light emitting diode in each amount of sealing resin of Example 4 is shown. (Dotted line: 1 mm of sealing resin ^{3}, 1.35 mm of dashed line:sealing resin ^{3}, 2.7 mm of solid line:sealing resin ^{3})
[Drawing 6]It is a typical sectional view of the SMD type light emitting diode in Example 5 of this invention.
[Drawing 7]It is a typical sectional view of another SMD type light emitting diode of this invention.
[Drawing 8]The emission spectrum of the purple-light-emission diode in Example 5 is shown.
[Description of Notations]
1 ... Substrate
2 ... Light emitting device
3, 4 ... Lead electrode
5 ... Conductive member
6 ... Fluorescent substance
7 ... Resin
8 ... Die bond resin

9 ... Gold streak

10 ... Cavity

11 ... Convex-lens-shape resin

12 ... Coloring matter

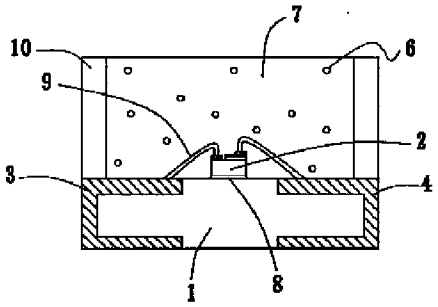
[Translation done.]

* NOTICES *

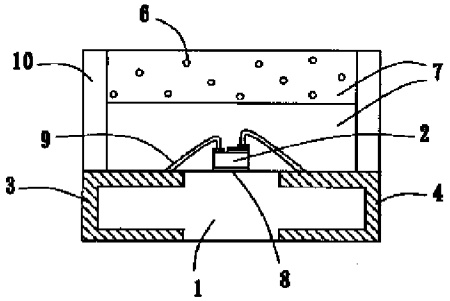
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

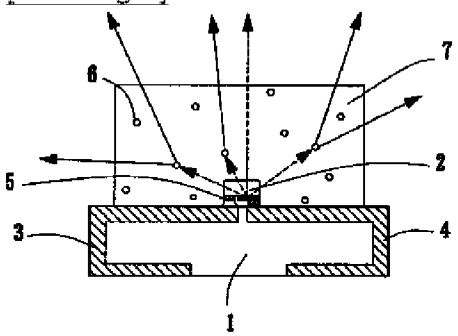
[Drawing 1]



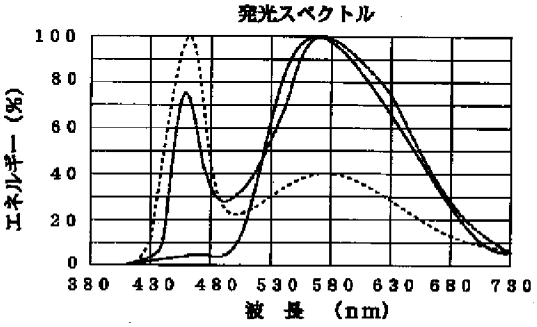
[Drawing 2]



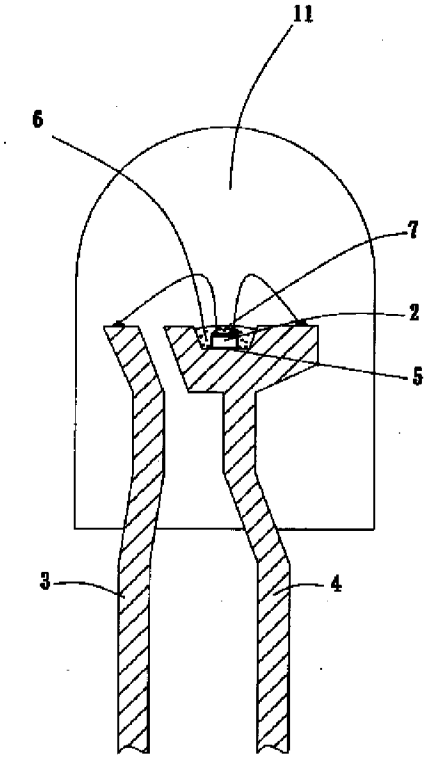
[Drawing 3]



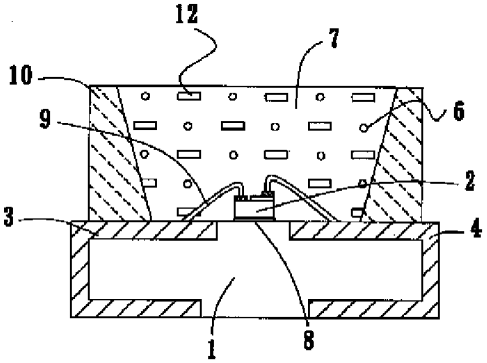
[Drawing 5]



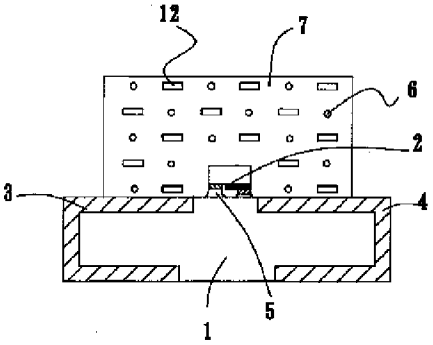
[Drawing 4]



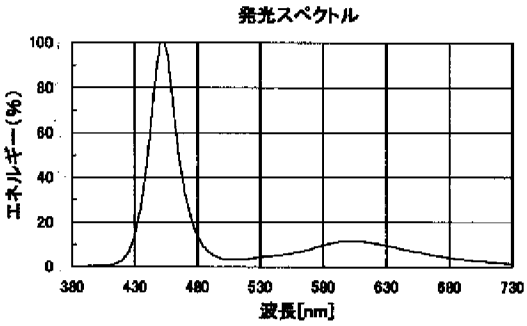
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]